Research paper

Elevated depression and anxiety predict future patterns of individualistic and collectivistic cultural values: A cross-lagged longitudinal network analysis

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A B S T R A C T

Background: Specific components of independent and interdependent self-construal have been associated with psychopathology. However, most studies on this topic have been cross-sectional, precluding causal inferences. We used contemporaneous and temporal cross-lagged network analysis to establish weak causal effects in understanding the association between self-construal and psychopathology components.
Methods: Middle-aged and older community-dwelling adults ($n = 3294$) participated in the Midlife Development in the United States study across two time-points, spaced nine years apart. Six self-construal (interdependence: connection to others, commitment to others, receptiveness to influence; independence: behavioral consistency, sense of difference from others, self-reliance) and three psychopathology nodes (major depressive disorder (MDD), generalized anxiety disorder (GAD), and panic disorder (PD) symptom severity) were examined. All network analyses controlled for age, sex, race, and number of chronic illnesses as covariates.
Results: Contemporaneous and temporal networks yielded relations between elevated MDD and PD and increased receptiveness to influence. Heightened GAD symptom severity was associated with future increased difference from others and decreased connection to others, commitment to others, and receptiveness to influence. Higher MDD, GAD, and PD severity were associated with future lower self-reliance. Network comparison tests revealed no consistent network differences across sex and race.
Limitations: DSM-III-R measures of MDD, GAD, and PD were used. Results may not generalize to culturally diverse racial groups.
Conclusions: Changes in self-construal may result from increased MDD, GAD, and PD severity. Findings suggest the importance of targeting common mental health symptoms to positively influence how individuals view the self and others in various social contexts.

1. Introduction

Major depressive disorder (MDD), generalized anxiety disorder (GAD), and panic disorder (PD) are highly prevalent and disabling mental health problems worldwide (de Jonge et al., 2016; GBD 2017 Disease and Injury Incidence and Prevalence Collaborators., 2018; Ruscio et al., 2017). There is cross-cultural variation in their prevalence (Asnaani et al., 2010; Grant et al., 2006; Grant et al., 2005; Hasin et al., 2005), possibly driven by cultural values leading to differences in clinical presentation, patient-provider communication, and treatment utilization (Betancourt et al., 2003; Kirmayer and Ryder, 2016; Sun et al., 2016). Individuals holding cultural values distinct from the dominant

culture may be more susceptible to negative mental health outcomes (Caldwell-Harris and Ayçiçegi, 2006). Thus, broadening and deepening our understanding of the cross-cultural risk factors and consequences of MDD, GAD, and PD symptoms is critical.

In this regard, cultural values of independent and interdependent self-construal are two factors to consider. Independent self-construal emphasizes independence from others by attending to the self and discovering and expressing unique inner attributes (Markus and Kitayama, 1991). Aspects of independent self-construal values include behavioral consistency ("I act the same way no matter who I am with"), difference from others ("I enjoy being unique and different from others in many respects"), and self-reliance ("Being able to take care of myself

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is a primary concern for me"). Conversely, interdependence highlights the fundamental interrelatedness of individuals (i.e., self as contextualized within a community). Aspects of interdependent self-construal values include connection to others ("My happiness depends on the happiness of those around me"), commitment to others ("I often have the feeling that my relationships with others are more important than my own accomplishments"), and receptiveness to influence ("It is important to listen to others' opinions").

Theorists (Triandis and Gelfand, 1998) have argued that aspects of cultural values emphasizing *difference from others* are associated with elevated psychopathology. This association may arise because individualistic communities encourage community members to value personal achievements over social relationships, leading to increased competitiveness. Individuals valuing difference from others may possess less detailed personal knowledge, such as knowing how others think and feel (Haberstroh et al., 2002; Triandis et al., 1988). They may also experience reduced self-esteem when others outperform them (Gardner et al., 2002). Substantiating this theory, empirical evidence has shown that aspects of independent self-construal related to *difference from others* were correlated with higher depression and anxiety (Humphrey et al., 2020).

Theorists have also posited that *behavioral consistency* is associated with lower levels of psychopathology, suggesting that consistency across social roles reflects self-concept organization and integrity (Allport, 1937; Donahue et al., 1993; Lecky, 1945). Thus, individuals may feel happiest and be seen as more authentic, likable, trustworthy, and warm in Western contexts when they are behaviorally consistent (Roberts and Donahue, 1994; West et al., 2018). Empirically, behavioral consistency has been linked to decreased anxiety and depression (Bleidorn and Ködding, 2013; Sheldon et al., 1997), as well as higher psychological adjustment across both individualistic and collectivistic cultures (Church et al., 2008). However, some theorists have argued that behavioral consistency may be seen as rigid and immature in interdependent cultures (Markus and Kitayama, 1994). Further research is needed to clarify the role of this aspect of self-construal in predicting depression and anxiety.

Self-reliance has been postulated to closely align with self-efficacy (i. e., individuals' belief in their ability to succeed) and self-care agency (i. e., individuals' belief in their ability to engage in self-care behaviors), both theorized to be associated with decreased psychopathology (Bandura, 1986; Orem, 1995). According to social cognitive theory, greater self-efficacy results in stronger belief that one will be efficacious in responding to potential threats, leading to lower anxiety and higher willingness to try coping tasks (Bandura, 1986). Self-care theory states that individuals maintain well-being when they are self-reliant and perform self-care independently (Orem, 1995). Supporting these theories, studies have found that higher self-efficacy and self-care agency were related to lower depression, anxiety, and panic (Robinson-Smith et al., 2000; Sandin et al., 2015; Sharma and Kumra, 2022; Soysa and Wilcomb, 2015; Zhang et al., 2021). Additionally, aspects of independent self-construal associated with self-reliance were unrelated to common mental health symptoms (Humphrey et al., 2020). Collectively, longitudinal studies are needed to test how self-reliance may be a predictor or consequence of common mental health symptoms.

It has also been argued that interdependent self-construal aspects related to *connection and commitment to others* are associated with lower levels of psychopathology due to emphasis on stable social relationships and cooperation (Triandis and Gelfand, 1998). Individuals who value connection to others should be more likely to use interpersonal strategies to develop and maintain social relationships, resulting in larger, closer, and more committed social networks (Cross et al., 2000). Additionally, individuals valuing commitment to others may prioritize relationships with others over prestige (Cristina-Corina, 2012), leading to higher levels of cooperation (Utz, 2004). Supporting this theory, components of interdependent self-construal emphasizing connection and commitment to others correlated with increased psychological well-

being (Humphrey et al., 2020). Research has also found that valuing cooperation, shared goals with others, and sociability were associated with less anxiety, stress, and emotional and behavioral difficulties (Germani et al., 2020; Xiao, 2021).

Furthermore, *receptiveness to influence* may be related to increased psychopathology (Coyne, 1976; Woody and Rachman, 1994). In the interpersonal theory of depression, depressed persons have high receptiveness to influence and engage in excessive reassurance-seeking to lessen feelings of guilt and low self-worth, leading to worsening symptoms (Coyne, 1976). According to the safety signal perspective of GAD, perceived loss of safety and unpredictable threats lead persons with GAD to engage in safety-seeking behavior, such as being overly dependent on influence and reassurance from others (Woody and Rachman, 1994). This perspective can be extended to PD, where triggers are unexpected (Woody and Rachman, 1994). Empirical studies have supported these theories, demonstrating that excessive reassurance-seeking and overvaluation of others' opinions were associated with depression and anxiety (Cougle et al., 2012; Joiner Jr. and Metalsky, 2001; Onur et al., 2007; Starr and Davila, 2008). Thus, cultures displaying high receptiveness to influence and overvaluation of others' opinions may be more susceptible to common mental health symptoms (Mak et al., 2011).

Despite the informative value of these studies above, their generalizability is limited. Most of these studies were cross-sectional or conducted on undergraduate students (Cougle et al., 2012; Germani et al., 2020; Humphrey et al., 2020; Joiner Jr. and Metalsky, 2001; Mak et al., 2011; Sandin et al., 2015; Sheldon et al., 1997; Soysa and Wilcomb, 2015; Xiao, 2021; Zhang et al., 2021). Additionally, only two examined these components within the framework of self-construal (Humphrey et al., 2020; Mak et al., 2011). Thus, there is a need for longitudinal studies to understand the *temporal* relations between aspects of self-construal and common mental disorders and to establish weak causal inferences (Hernán et al., 2019). The current prospective study extended the literature by examining how interdependence and independence related to common mental health symptoms across time in community-dwelling adults, to inform this population's culturally-tailored mental health interventions (Hwang et al., 2018).

Additionally, it is tenable that the experience of heightened depression and anxiety and related constructs could alter future interdependent and independent self-construal. Lower self-esteem has been found to predict decreased levels of specific self-construal components, namely self-expression (vs. harmony) and behavioral variability (vs. consistency; Moza et al., 2019). Lower self-esteem has also been associated with elevated depression and anxiety (Batelaan et al., 2010; Sowislo and Orth, 2013). We are unaware of any studies that have explicitly examined the effect of psychopathology on interdependent and independent self-construal. Thus, it is necessary to investigate the impact of common mental health symptoms on self-construal components to determine specific prevention and treatment targets.

Accordingly, the current study examined which dimensions of interdependent and independent self-construal predicted depression and anxiety utilizing cross-lagged panel network analysis (CLPN; Wysocki et al., 2022). CLPN confers advantages over ordinary least squares regression and structural equation modeling in that it allows for examination of how *components*, rather than mean-overall scores or latent constructs, relate to each other bidirectionally both within and between persons (Wysocki et al., 2022). We aimed to explicate the relations between six nodes of self-construal (Interdependence: Connection to others, Commitment to others, Receptiveness to influence; Independence: Behavioral consistency, Difference from others, Self-reliance) and three nodes of psychopathology (MDD, GAD, and PD). Regarding interdependent nodes, we predicted that receptiveness to influence but not a commitment or connection to others would predict greater future depression and anxiety symptoms and vice versa. This hypothesis would align with evidence relating overvaluation of others' opinions, but not connection to others, to higher depression and anxiety (Humphrey et al., 2020; Mak et al., 2011). Concerning independent nodes, we

hypothesized that difference from others rather than behavioral consistency and self-reliance would predict higher levels of later anxiety and depression symptoms. This hypothesis would be consistent with prior literature (e.g., Humphrey et al., 2020) that found that independent self-construal components emphasizing social comparison and difference from others were correlated with higher depression and anxiety and vice versa.

2. Methods

2.1. Participants

Participants were involved in the Midlife Development in the United States (MIDUS) project across two waves of data collection: Wave 1 (W1: 2004 to 2006) and Wave 2 (W2: 2013 to 2014; details available in Ryff et al., 2019; Ryff et al., 2017). The first wave of data collection occurred from 1995 to 1996, but we did not include that data as self-construal was not evaluated. The current study did not require additional Institutional Review Board (IRB) approval as the MIDUS dataset is publicly available via an online data repository (https://tinyurl.com/cwdh6rwz). However, the original MIDUS investigators received IRB approval from participating institutions. A total of 3294 participants (54.95% female) averaged 54.54 years (*SD* = 11.36, range = 30 to 84 years) at baseline, and 41.99% had at least a Bachelor's degree. The sample comprised primarily White participants (91.86%) or African American, Asian, Native American, Pacific Islander, or other ethnicity participants (8.14%). A proportion of participants met diagnostic threshold for MDD (10.02%; *n* = 330), GAD (2.00%; *n* = 66), and PD (6.10%; *n* = 201). The MIDUS dataset excluded serious mental illnesses such as bipolar disorder and disorders of psychosis.

2.2. Components of interdependence/independence

Aspects of interdependence/independence were determined using items from the Self-Construal Scale (Singelis, 1994). Participants rated each item on a 7-point Likert-scale (1 = *Strongly Agree* to 7 = *Strongly Disagree*) to indicate how much they agreed with the statement. Each component examined corresponded to one item on the scale. Components of interdependent self-construal included *connection to others* ("My happiness depends on the happiness of those around me"), *commitment to others* ("I often have the feeling that my relationships with others are more important than my own accomplishments"), and *receptiveness to influence* ("It is important to listen to others' opinions"). Components of independent self-construal included *behavioral consistency* ("I act in the same way no matter who I am with"), *difference from others* ("I enjoy being unique and different from others in many respects"), and *self-reliance* ("Being able to take care of myself is a primary concern for me"). Internal consistency coefficients cannot be computed on single items, but research has demonstrated that single items showed strong concurrent validity and good predictive validity (Gogol et al., 2014; Song et al., 2022).

2.3. Symptom severity

MDD, PD, and GAD symptom severity were scored using the Diagnostic and Statistical Manual–Third Edition–Revised (DSM-III-R) Composite International Diagnostic Interview–Short Form (CIDI-SF; American Psychiatric Association, 1987; Kessler et al., 1998; Wittchen, 1994) based on the past 12 months. MDD severity evaluated seven symptoms: depressed mood, anhedonia, appetite change, concentration issues, fatigue, suicidal ideation, and sleep disturbance. Participants endorsed either the presence (coded as '1') or the absence ('0') of each symptom, with a total severity score of 0 to 7 on the MDD severity scale. GAD severity evaluated ten symptoms due to worry (e.g., restlessness, muscle soreness or tension, irritability, trouble focusing, sleep disturbance, easily fatigued). Participants reported the frequency and degree

to which they experienced these symptoms and rated them on a 4-point Likert scale (0 = *Never* to 3 = *Most Days*). The total severity score was calculated by summing the total of "Most Days" responses to the items, ranging from 0 to 10 on the GAD severity scale. Lastly, PD severity evaluated six symptoms: heart palpitations, chest or stomach discomfort, hot flashes, trembling or shaking, sweating, and surroundings seeming unreal. Participants endorsed either the presence (coded as '1') or the absence ('0') of each symptom, with a total severity score range of 0 to 6. Table 1 displays descriptive statistics of all study variables.

2.4. Data analyses

All analyses were conducted using *R* (Version 4.2.0) and *RStudio* (Version 2021.09.0.351) software (RStudio Team, 2021). Before performing network analysis, multiple imputation on the individual-level data was conducted using the *mice R* package (van Buuren and Groothuis-Oudshoorn, 2011) to manage missing data (7.89% of total observations). Multiple imputation is a gold standard approach for data that is likely missing at random. It maximizes power by using all relevant available data (Audigier et al., 2018; Grund et al., 2018) and yields more accurate parameter estimates than listwise and pairwise deletions (van Ginkel et al., 2020). Data were aggregated across 10 multiple imputed data sets, each with up to 100 iterations, using a predictive mean matching algorithm.

Next, we conducted CLPN by examining three psychopathology and six self-construal indices from W1 to W2. Based on prior research (Zainal and Newman, 2021; Zainal and Newman, 2023b; Zainal and Newman, 2023a), we added the following variables as covariates: age, sex at birth, race, and chronic physical illness. All network analyses were performed with the *bootnet* (Epskamp et al., 2018), *glmnet* (Friedman et al., 2010), *networktools* (Haslbeck and Waldorp, 2018; Jones, 2020), and *qgraph* (Epskamp et al., 2012) *R* packages. First, network graphs were constructed in which nodes closer to one another had higher associations and nodes nearer to the center had more connections with other nodes. A graphical Gaussian model (GGM; Epskamp et al., 2012) was used to display edges (relations between nodes after adjusting for the influence of all other nodes). GGMs were regularized using the least absolute shrinkage and selection operator (LASSO), which reduced all edges, particularly weak or trivial edges (i.e., unimportant network relations), to zero to decrease the odds of false positive edges in the network. The graphical LASSO was utilized with the extended Bayesian information criterion (EBIC) model selection, and the model with the lowest EBIC value out of 100 estimated was chosen. We specified a hyperparameter value of $\gamma = 0.5$ value to balance between sensitivity (i.e., eliminating true edges) and specificity (i.e., including false-positive edges), maximizing the chances that genuine edges were chosen. CLPN also tested the effects of prior nodes on all other nodes at the next time-point after adjusting for auto-regressive effects (i.e., a unique node predicting itself at a later time-point) and baseline scores of all concurrently measured nodes.

Additionally, we calculated centrality indices to determine the importance of each node. We computed (1) *in-prediction*: the extent to which the proportion of variance of a specific node at W2 is impacted by nodes of the other cross-construct cluster at W1, and (2) *out-prediction*: the degree to which a unique W1 node accounts for the variance of nodes of the other cross-construct cluster at W2, and (3) *two-step bridge EI*: the amount of importance each node has in relating to nodes of the other cross-construct cluster (Jones, 2020). The two-step bridge EI included bridge *EI1* (the total sum of edge weights between a unique node and those of the other cluster) and bridge *EI2* (the ancillary effect of a unique node through the impact of nodes in its vicinity). Higher bridge EI values indicate a more substantial influence over other community nodes. The accuracy and stability of these network metrics were assessed using 1000 iterations in the bootstrapped estimation procedure (McNally, 2021). Edge weights with 95% confidence interval (CI) and correlation stability (CS) coefficients were calculated (Epskamp et al., 2018), with

Table 1
Descriptive statistics of network components.

	INT (Connection to others)	INT (Commitment to others)	INT (Receptiveness to influence)	IND (Behavioral consistency)	IND (Difference from others)	IND (Self-reliance)	MDD	GAD	PD
Wave 1									
M	3.91	3.98	1.93	3.07	2.84	2.41	0.50	0.13	0.31
(SD)	1.97	1.82	1.08	1.87	1.55	1.59	1.61	0.87	0.99
Min	1	1	1	1	1	1	0	0	0
Max	7	7	7	7	7	7	7	10	6
Skewness	0.25	0.22	1.70	0.61	0.77	1.25	3.08	7.65	3.50
Kurtosis	−1.34	−1.14	4.00	−0.97	−0.05	0.78	7.98	61.81	11.88
Wave 2									
M	3.87	4.05	2.01	2.91	2.73	2.17	0.47	0.13	0.27
(SD)	1.89	1.76	1.14	1.75	1.46	1.42	1.57	0.92	0.92
Min	1	1	1	1	1	1	0	0	0
Max	7	7	7	7	7	7	7	10	6
Skewness	0.30	0.17	1.46	0.72	0.85	1.47	3.21	7.89	3.73
Kurtosis	−1.22	−0.98	2.63	−0.62	0.29	1.85	8.81	65.51	13.91

Note. M = mean; *SD* = standard deviation; Min = minimum; Max = maximum; INT = Interdependence; IND = Independence; MDD = Major depressive disorder; GAD = Generalized anxiety disorder; PD = Panic disorder.

CS values ≥0.50 demonstrating good stability and CS values ≥0.25 indicating acceptable stability. We presented partial correlation coefficients (*r*) for contemporaneous networks and Cohen's *d* effect sizes for temporal networks to facilitate interpretation (Dunlap et al., 1996; Dunst et al., 2004).

Lastly, we partitioned participants into groups based on sex and race and estimated separate contemporaneous networks for these groups at both time points to evaluate if there were statistically significant differences between networks. Race was dichotomized as "non-White" and "White" due to the small portion of participants who identified as non-White. Comparisons were performed using the *NetworkComparisonTest* package (NCT; van Borkulo et al., 2022) with a permutation seed value
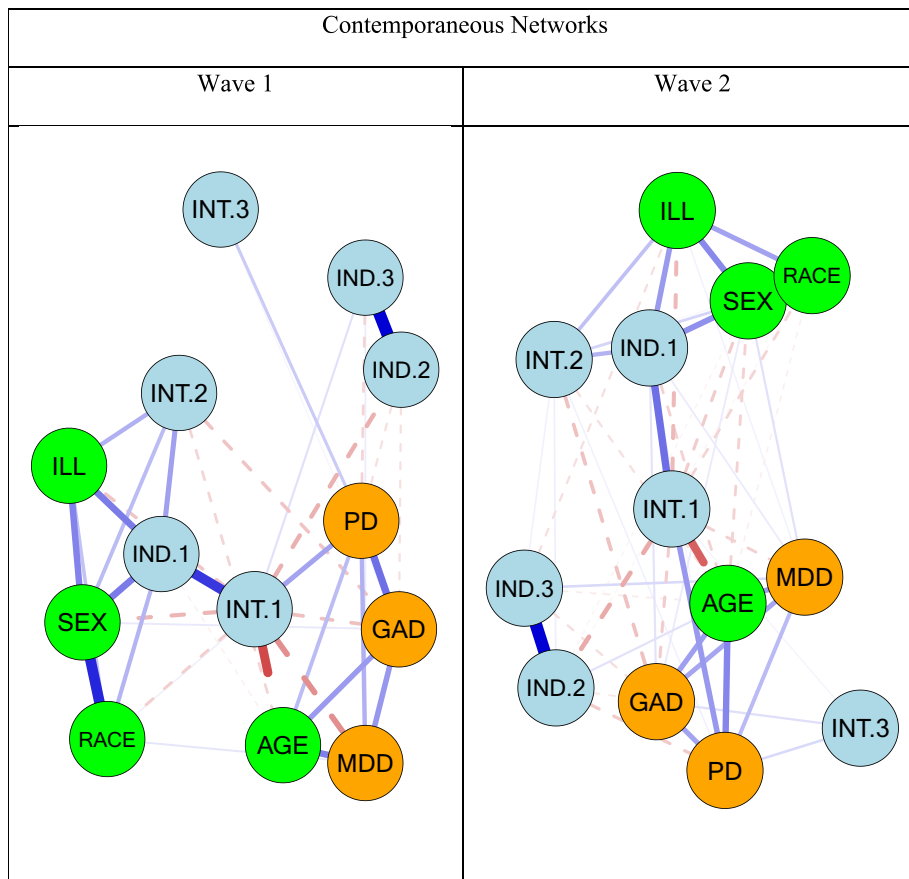

Fig. 1. Contemporaneous networks of self-construal and psychopathology components.
Note: INT.1 = Connection to Others; INT.2 = Commitment to Others; INT.3 = Receptiveness to Influence; IND.1 = Behavioral Consistency; IND.2 = Difference from Others; IND.3 = Self-reliance; MDD = Major depressive disorder; GAD = Generalized anxiety disorder; PD = Panic disorder. AGE = Age; SEX = Sex at birth; RACE = Race; ILL = Chronic physical illness; Solid lines show positive relations, dashed lines indicate negative relations, and line thickness reflects the strength of associations.

of "123" for stable reproducibility and 1000 permutations. We investigated network invariance (possible edge weight differences) and global strength invariance (possible difference in the absolute sum of network edge weights).

3. Results

3.1. Contemporaneous networks

Fig. 1 shows the contemporaneous networks during W1 and W2, where solid lines indicate positive relations (or edges), dashed lines signal negative relations, and thicker lines reflect stronger network associations. Table 2 displays the strongest undirected edges within and across constructs. Across self-construal and psychopathology network clusters, the strongest consistent true edges were among two aspects of independence and MDD (self-reliance: $r = -0.025$; behavioral consistency, $r = 0.022$). The self-construal components with the highest bridge EIs were connection to others (interdependence; bridge $EI1 = -0.628$, bridge $EI2 = -0.797$) and behavioral consistency (independence; bridge $EI1 = 0.595$, bridge $EI2 = 0.898$). Within the community of psychopathology nodes, GAD had the largest bridge EI (i.e., influence over other community nodes; bridge $EI1 = -0.007$, bridge $EI2 = 0.084$). Metrics for the contemporaneous networks showed high stability for edge strength (W1 and W2: $CS = 0.750$, 95 % CI [0.672, 1.000]) and bridge EI (W1: $CS = 0.750$, 95 % CI [0.672, 1.000]; W2: $CS = 0.672$, 95 % CI [0.594–0.750]).

3.2. Temporal networks

Fig. 2 shows the CLPN, with arrows relaying temporal associations of the edges within and across constructs. Non-demographic nodes with the greatest auto-regression coefficients were difference from others (independence, $r = 0.464$) and behavioral consistency (independence, $r = 0.404$). Table 3 displays the strongest directed edges within and across constructs or clusters. Across self-construal and psychopathology nodes, higher W1 PD and MDD were both related to higher W2 receptiveness to influence (interdependence; PD: $d = 0.013$; MDD: $d = 0.012$) but W1 receptiveness to influence (interdependence) only correlated with W2 MDD ($d = -0.002$). Also, higher W1 GAD was associated with higher W2 difference from others (independence; $d = 0.012$), but the correlation was negatively signed for the reverse association ($d = -0.008$). Additionally, higher W1 GAD correlated with lower W2 commitment to others (interdependence; $d = -0.058$), connection to others (interdependence; $d = -0.083$) and receptiveness to influence (interdependence; $d = -0.021$) but not vice versa. As shown in Fig. 3, across clusters, the most impactful nodes with highest out-prediction and low in-prediction values were sex (out-prediction: $\beta = 12.563$; in-prediction: $\beta = 12.625$), race (out-prediction: $\beta = 11.974$; in-prediction: $\beta = 12.000$), and GAD (out-prediction: $\beta = 12.183$, in-prediction: $\beta = 12.625$). Additionally, the least influential nodes with low out-prediction and highest in-prediction values were number of comorbid physical illnesses (in-prediction: $\beta = 12.066$; out-prediction: $\beta = 12.136$) and MDD (in-prediction: $\beta = 12.116$, out-prediction: $\beta = 12.000$). Moreover, temporal network metric coefficients showed strong stability for edge strength ($CS = 0.750$, 95% CI [0.672, 1.000]), in-prediction ($CS = 0.750$, 95% CI [0.672, 1.000]), and out-prediction ($CS = 0.750$, 95% CI [0.672, 1.000]).

3.3. Network comparison tests

Network comparison tests demonstrated no significant network structure differences based on sex or race. Networks based on sex did not differ significantly in the network invariance test (W1: test statistic $M = 0.106$, $p = .263$; W2: $M = 0.113$, $p = .199$). Global strength was significantly higher in the female sample at W1 (test statistic $S = 1.718$, $p = .004$), indicating that the network for the female sample had

Table 2
Strongest undirected edges of contemporaneous networks.

Undirected edge weight	W1	W2	Average
INT (Connection to others)-INT (Commitment to others)	0.237	0.284	0.261
MDD-GAD	0.203	0.229	0.216
Age-Physical illness	0.185	0.161	0.173
Physical illness-MDD	0.124	0.124	0.124
MDD-PD	0.115	0.132	0.123
IND (Behavioral consistency)-IND (Difference from others)	0.135	0.103	0.119
Physical illness-PD	0.122	0.113	0.118
INT (Receptiveness to influence)-IND (Self-reliance)	0.119	0.111	0.115
Age-IND (Difference from others)	0.086	0.115	0.101
IND (Behavioral consistency)-IND (Self-reliance)	0.094	0.107	0.100
IND (Difference from others)-IND (Self-reliance)	0.063	0.136	0.099
INT (Receptiveness to influence)-IND (Behavioral consistency)	0.097	0.100	0.098
Sex-Physical illness	0.088	0.085	0.087
GAD-PD	0.057	0.103	0.080
INT (Receptiveness to influence)-IND (Difference from others)	0.074	0.077	0.075
Sex-PD	0.074	0.070	0.072
Sex-MDD	0.063	0.048	0.055
Physical illness-GAD	0.070	0.036	0.053
INT (Commitment to others)-INT (Receptiveness to influence)	0.018	0.043	0.030
IND (Behavioral consistency)-MDD	0.021	0.023	0.022
INT (Receptiveness to influence)-MDD	0.000	0.034	0.017
Physical illness-IND (Behavioral consistency)	0.000	0.031	0.016
INT (Connection to others)-IND (Self-reliance)	0.000	0.032	0.016
Age-INT (Commitment to others)	0.028	0.003	0.015
Physical illness-INT (Receptiveness to influence)	0.005	0.022	0.014
Sex-INT (Connection to others)	0.006	0.018	0.012
INT (Receptiveness to influence)-GAD	0.023	0.000	0.012
Sex-INT (Commitment to others)	0.000	0.016	0.008
Sex-IND (Difference from others)	0.000	0.015	0.008
Physical illness-IND (Difference from others)	0.003	0.011	0.007
IND (Difference from others)-GAD	0.014	0.000	0.007
INT (Receptiveness to influence)-PD	0.000	0.015	0.007
Sex-GAD	0.000	0.009	0.005
INT (Commitment to others)-GAD	−0.004	0.000	−0.002
INT (Connection to others)-GAD	0.000	−0.011	−0.005
INT (Connection to others)-MDD	0.000	−0.012	−0.006
IND (Self-reliance)-GAD	0.000	−0.018	−0.009
INT (Commitment to others)-IND (Self-reliance)	0.000	−0.021	−0.011
INT (Commitment to others)-IND (Behavioral consistency)	0.000	−0.037	−0.018
INT (Commitment to others)-PD	0.000	−0.036	−0.018
INT (Commitment to others)-IND (Difference from others)	−0.040	0.000	−0.020
IND (Self-reliance)-MDD	0.000	−0.050	−0.025
INT (Connection to others)-IND (Behavioral consistency)	−0.029	−0.026	−0.028
Physical illness-IND (Self-reliance)	−0.014	−0.050	−0.032
Sex-IND (Self-reliance)	−0.039	−0.035	−0.037
INT (Connection to others)-IND (Difference from others)	−0.029	−0.059	−0.044
Age-GAD	−0.045	−0.048	−0.047
Age-IND (Behavioral consistency)	−0.059	−0.055	−0.057
Sex-IND (Behavioral consistency)	−0.055	−0.070	−0.062
Age-MDD	−0.068	−0.057	−0.062
Age-PD	−0.054	−0.078	−0.066
Age-INT (Receptiveness to influence)	−0.104	−0.051	−0.077
Age-INT (Connection to others)	−0.073	−0.095	−0.084
Age-IND (Self-reliance)	−0.169	−0.176	−0.173

Note. MDD = Major depressive disorder; GAD = Generalized anxiety disorder; PD = Panic disorder; INT = Interdependence; IND = Independence; W1 = wave 1; W2 = wave 2.

stronger connectivity. However, this finding did not hold at W2 ($S = 0.010$, $p = .910$). Regarding race, there were no significant differences in both network structure (W1: $M = 0.225$, $p = .738$; W2: $M = 0.242$, $p = .543$) and global strength (W1: $S = 3.532$, $p = .362$; W2: $S = 2.938$, $p = .849$) between networks for the non-White sample compared to the
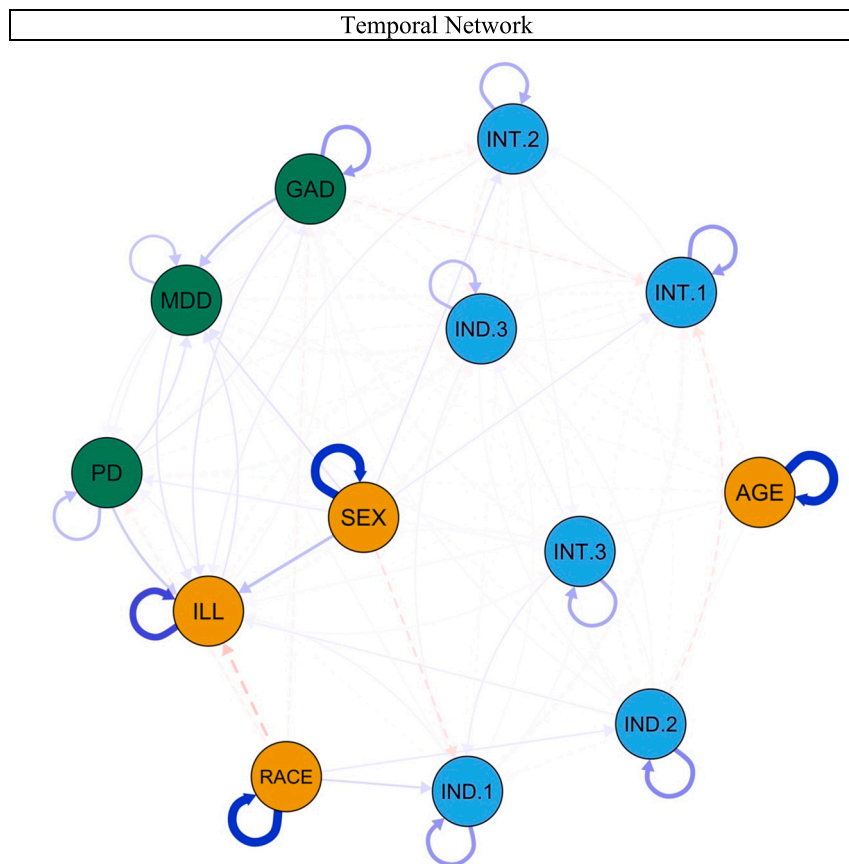
Fig. 2. Temporal network of self-construal and psychopathology components.
Note: ILL = Physical illness; INT.1 = Connection to Others; INT.2 = Commitment to Others; INT.3 = Receptiveness to Influence; IND.1 = Behavioral Consistency; IND.2 = Difference from Others; IND.3 = Self-reliance; MDD = Major depressive disorder; GAD = Generalized anxiety disorder; PD = Panic disorder. Solid lines show positive relations, dashed lines indicate negative relations, and line thickness reflects the strength of associations.

White sample.

4. Discussion

The current study offered a novel network perspective on the associations among various components of self-construal and psychopathology. CLPN-derived contemporaneous networks showed that higher *behavioral consistency* predicted higher MDD, whereas higher *difference from others* predicted higher GAD. Additionally, elevated *receptiveness to influence* predicted heightened MDD, GAD, and PD. Temporal networks demonstrated that higher *connection to others* predicted decreased MDD and PD, but the influence of *difference from others* and *behavioral consistency* was inconsistent. Notably, temporal networks across two time-points did not necessarily align with contemporaneous networks. We provide plausible theoretical accounts for the current study's findings and the degree of similarities and discrepancies with previous literature.

Within contemporaneous and temporal networks, higher ratings on behavioral consistency (independence) were associated with elevated MDD. These findings are inconsistent with previous literature showing positive outcomes related to behavioral consistency (Bleidorn and Ködding, 2013; Church et al., 2008; Clifton and Kuper, 2011; Sheldon et al., 1997). These results may be explained by evidence linking behavioral inflexibility to MDD (Stange et al., 2017). Behavioral inflexibility in depression may stem from neurobiological deficits that impair flexible engagement with external stimuli (Price and Duman, 2020). Additionally, impairments in reward processing may lead to "tunnel vision" during decision-making, further leading to behavioral inflexibility.

Contemporaneous networks demonstrated that higher receptiveness

to influence (interdependence) was related to heightened MDD, and temporal networks showed that increased MDD predicted stronger receptiveness to influence. Contemporaneous networks were consistent with previous research that linked excessive reassurance-seeking and overvaluation of others' opinions to depression at a single time-point (Mak et al., 2011; Onur et al., 2007; Starr and Davila, 2008). However, the relationship between receptiveness to influence and depression may be bidirectional. Depressive symptoms may lead to higher receptiveness to influence through a negative feedback loop driven by relational uncertainty (i.e., ambiguity regarding the status of relationships and one's involvement in them; Knobloch and Solomon, 1999). Cross-sectional studies have found that depressed persons displayed high levels of relational uncertainty (Knobloch and Knobloch-Fedders, 2010), associated with excessive reassurance-seeking to obtain relationship status cues (Knobloch et al., 2011). Qualitatively, depressed persons have described how depression resulted in relational uncertainty (Sharabi et al., 2015), possibly due to heightened feelings of rejection, unhappiness, and detachment (Knobloch and Delaney, 2012). Thus, the desire for information regarding interpersonal relationships may lead to higher perceived importance of listening to others' opinions. Future studies can further test this association longitudinally.

Contemporaneous networks showed that greater difference from others (taking pleasure in not being like others) was associated with heightened GAD. This finding is consistent with the results of Humphrey et al. (2020), who reasoned that this was due to increased social comparison and competitiveness associated with this component of independence. Appraising oneself as autonomous from others may cause an individual to see the successes of others as superior to their performance, leading to self-esteem injuries and future anxiety (Gardner et al., 2002).

Table 3
Strongest directed edges of temporal network from wave 1 to wave 2.

Directed edge weight	d
PD-Physical illness	0.181
Race-IND (Behavioral consistency)	0.128
Sex-MDD	0.097
GAD-Physical illness	0.095
MDD-Physical illness	0.087
Sex-INT (Commitment to others)	0.086
Physical illness-MDD	0.085
Race-IND (Difference from others)	0.075
Sex-INT (Connection to others)	0.067
Sex-PD	0.059
IND (Difference from others)-Physical illness	0.056
INT (Commitment to others)-Physical illness	0.052
Physical illness-PD	0.040
IND (Behavioral consistency)-Physical illness	0.033
INT (Receptiveness to influence)-Physical illness	0.024
Physical illness-GAD	0.018
Physical illness-INT (Receptiveness to influence)	0.018
IND (Behavioral consistency)-MDD	0.014
PD-INT (Receptiveness to influence)	0.013
MDD-INT (Receptiveness to influence)	0.012
GAD-IND (Difference from others)	0.012
Age-IND (Difference from others)	0.009
Sex-GAD	0.003
Sex-INT (Receptiveness to influence)	0.002
Race-IND (Self-reliance)	0.001
Age-IND (Behavioral consistency)	−0.001
Physical illness-INT (Commitment to others)	−0.002
IND (Behavioral consistency)-PD	−0.002
INT (Receptiveness to influence)-MDD	−0.002
Age-GAD	−0.003
Age-INT (Receptiveness to influence)	−0.004
MDD-INT (Commitment to others)	−0.004
IND (Self-reliance)-MDD	−0.004
Physical illness-INT (Connection to others)	−0.005
Age-PD	−0.007
INT (Connection to others)-PD	−0.007
IND (Self-reliance)-GAD	−0.007
Age-MDD	−0.007
IND (Difference from others)-GAD	−0.008
IND (Self-reliance)-PD	−0.010
INT (Connection to others)-MDD	−0.012
Age-INT (Connection to others)	−0.012
INT (Connection to others)-Physical illness	−0.012
Age-IND (Self-reliance)	−0.013
IND (Difference from others)-MDD	−0.013
GAD-IND (Self-reliance)	−0.020
IND (Self-reliance)-Physical illness	−0.020
GAD-INT (Receptiveness to influence)	−0.021
PD-IND (Self-reliance)	−0.029
Physical illness-IND (Self-reliance)	−0.030
MDD-IND (Self-reliance)	−0.031
Race-GAD	−0.056
GAD-INT (Commitment to others)	−0.058
Race-PD	−0.063
GAD-INT (Connection to others)	−0.083
Sex-IND (Behavioral consistency)	−0.121

Note. MDD = Major depressive disorder; GAD = Generalized anxiety disorder; PD = Panic disorder; INT = Interdependence; IND = Independence.

However, temporally, the reverse association was observed, such that elevated GAD predicted future higher ratings on difference from others (independence). This finding might be explained by intolerance of uncertainty and perfectionism, i.e., both characteristics that have been linked to GAD symptoms (Gentes and Ruscio, 2011; Tyler et al., 2021). Interpersonal worries are common in GAD (Roemer et al., 1997). Persons with GAD may attempt to manage interpersonal uncertainty through social comparison (Butzer and Kuiper, 2006). Elevated perfectionism in GAD may also lead individuals to use social comparison to evaluate their status relative to others (Wyatt and Gilbert, 1998).

GAD also resulted in decreases in all three nodes of interdependent self-construal (connection to others, commitment to others, and receptiveness to influence). Such findings might be explained by elevated

interpersonal difficulties experienced by individuals with GAD (Beesdo et al., 2010; Whisman, 2007) driven by maladaptive social cognitions (Erickson and Newman, 2007; Zainal and Newman, 2018) that may lead them to withdraw from social engagement or underestimate their negative impression on others. Experiencing heightened interpersonal conflict linked to pathological worry may lead these individuals to place less value on social relationships, thus resulting in lower ratings on connection to others (feeling that happiness depends on the happiness of those around them) and commitment to others (valuing interpersonal relationships over achievements). GAD resulting in lower ratings on receptiveness to influence could reflect suspiciousness and hypervigilance associated with anxiety and the disorder more broadly (Gasperini et al., 1990; Sun et al., 2019). Future prospective and experimental studies could empirically test the validity of these conjectures.

Temporal networks also indicated that PD predicted increased future receptiveness to influence (interdependence). Persons with PD may seek advice and reassurance from others to obtain safety (Woody and Rachman, 1994). Cross-sectionally, higher panic symptoms were correlated with more person-focused safety behaviors that emphasized affiliation with others (Aafjes-van Doorn et al., 2019). Perception of uncontrollable stressors may erode self-confidence, which would likely lead to seeking and relying on others' advice (Gino et al., 2012). Higher receptiveness to influence may be driven by developmental risk factors of PD, such as anxious attachment (Newman et al., 2016) and high separation anxiety (Kossowsky et al., 2013). These ideas await empirical testing through prospective studies.

Lastly, higher MDD, GAD, and PD severity predicted lower self-reliance (independence) and vice versa. Individuals with these disorders may tend to be more interpersonally dependent (Sanathara et al., 2003; Stewart et al., 1992; Yoon and Zinbarg, 2007). Additionally, heightened psychopathology may lead to lower valuation of self-reliance through feelings of helplessness and worthlessness, which may be antecedents of chronic and recurrent depression and anxiety (Joshanloo, 2023; Meuret et al., 2010; Sowislo and Orth, 2013; Wiersma et al., 2011). Individuals with low perceived control or low self-esteem (commonly observed in MDD, GAD, and PD) may be less motivated to engage in self-care activities such as exercising, keeping a healthy diet, and maintaining social relationships (Harris and Orth, 2020; Infurna et al., 2011; Park et al., 2022; Povey et al., 2000), leading to functional disability (Infurna and Gerstorf, 2014; Tanner et al., 2019; van Wanrooij et al., 2019) and other outcomes closely linked to self-reliance over time. This may lead to a downward spiral where reduced self-reliance heightens future common mental health symptoms.

The current CLPN-derived findings can translate to clinical practice by prioritizing GAD, the most centrally influential symptom node with the highest out-prediction in the temporal network, as a chief treatment target. Since GAD predicted lower interdependence overall, clinicians can address deficits in interpersonal knowledge and skills regarding how others think and feel stemming from pathological worry (Zainal and Newman, 2018). Persons with GAD who are high in chronic worry may have dysfunctional interpersonal styles, leading to doubts about problem-solving abilities and rigid approaches, making effective problem-solving difficult in relational contexts (Llera and Newman, 2020; Malivoire and Koerner, 2022). Treatments focusing on helping patients adopt a more positive problem orientation and developing action plans to reduce psychological distress may benefit this disorder (Ladouceur et al., 2000). Neuroimaging research suggests that dysregulation in neural activity associated with mentalization and introspective thinking relates closely to GAD patients' inability to stop worrying (Paulesu et al., 2010). Therefore, mentalization-based treatments (Luyten et al., 2020) aimed to increase a patient's ability to interpret behaviors in oneself and others as an expression of inner mental processes may help alleviate interpersonal issues in GAD.

Additionally, temporal networks demonstrated that MDD and PD (but not GAD) predicted increased receptiveness to influence. This finding suggests clinicians need to target GAD and PD differently, as
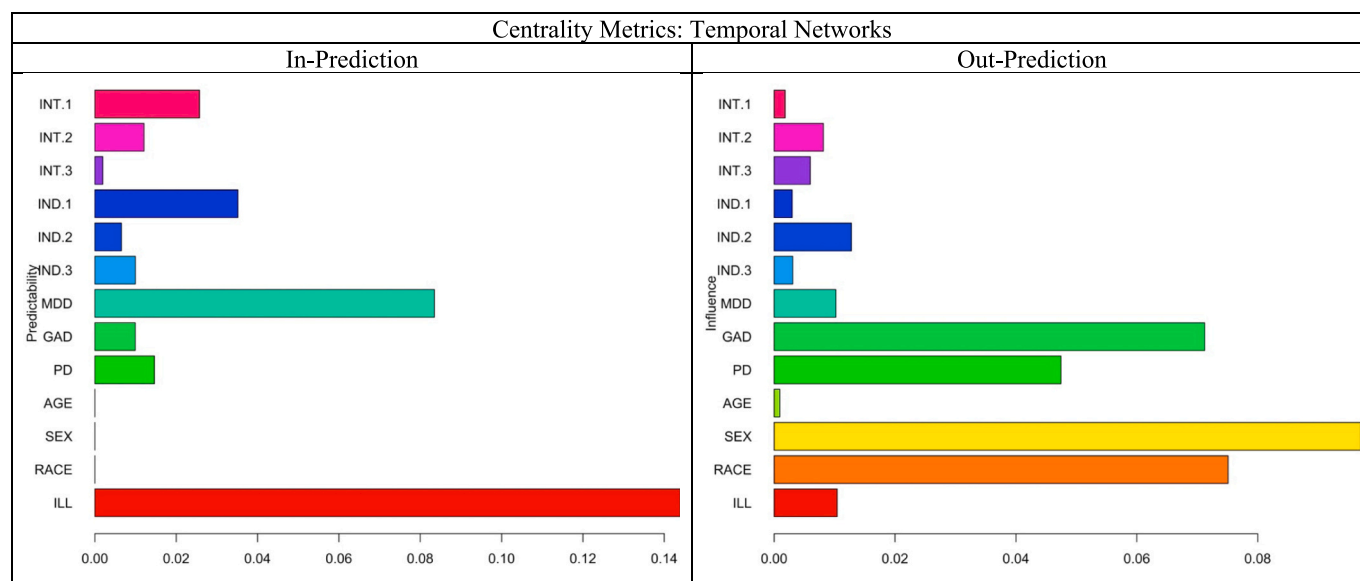
Fig. 3. In-prediction and out-prediction of temporal network.
Note: INT.1 = Connection to Others; INT.2 = Commitment to Others; INT.3 = Receptiveness to Influence; IND.1 = Behavioral Consistency; IND.2 = Difference from Others; IND.3 = Self-reliance; MDD = Major depressive disorder; GAD = Generalized anxiety disorder; PD = Panic disorder; ILL = Physical illness.

pathological worry and panic are different constructs (Barlow et al., 1984; Gross and Eifert, 1990). Instead of increasing interpersonal knowledge, clinicians treating MDD and PD should target interpersonal dependence, agency, and self-efficacy issues. These issues could lead to unrealistic interpersonal goals (Lynch et al., 2001) and increased loneliness (Cohen-Mansfield et al., 2016), perpetuating depression and panic symptoms. Social isolation and loneliness are common in middle-aged and older adults, especially those with more intense depression and panic symptoms (Ong et al., 2016; Perissinotto et al., 2012). Therefore, treatments aimed at increasing social connectedness and engagement with significant others may be especially effective for persons with MDD and PD (Giebel et al., 2022; Solomonov et al., 2019). Moreover, clinicians should focus on modifying worry and panic as they have a downstream effect on depression instead of targeting depression first.

The present study had some limitations. First, composite DSM-III-R measures of MDD, GAD, and PD were used. Therefore the study may not generalize to DSM-5 criteria (American Psychiatric Association, 2013). Assessments based on the DSM-III-R were the most updated measures available at the time of first data collection, and measures were kept consistent across all years of data collection. However, a meta-analysis of changes from the DSM-III to DSM-5 found no significant diagnostic inflation or deflation across revisions (Fabiano and Haslam, 2020). Nonetheless, future studies could examine the relations between components of self-construal and individual symptoms of these disorders with DSM-5-consistent assessments. Second, given the primarily White sample, our results may not generalize to all racial groups. Although network comparison tests across race and sex indicated there were no significant differences in network structure and overall edge strength, it is possible that we did not have sufficient diversity to detect differences. Moreover, the sample only included individuals residing in the U.S., which generally endorses and rewards an independent self-construal, possibly contributing to decreased psychological well-being for participants with an interdependent self-construal (Hyun, 2000). Nonetheless, strengths of the current study include its longitudinal design, the large sample of community-dwelling middle-aged and older adults, and the use of a statistical technique that facilitated weak causal inferences (Blackwell and Glynn, 2018) to clarify how components of self-construal relate to common mental health symptoms. An advantage network analysis has over ordinary least squares regression and structural equation modeling approaches is that it examines how

components, instead of mean-overall scores, mutually relate to each other across multiple time points (Wysocki et al., 2022). Additionally, the current study extends previous literature by being the first to examine the effect of psychopathology on self-construal explicitly. Knowledge of how common mental health symptoms influence cultural values can inform cultural tailoring of treatments for diverse populations (Huey Jr. et al., 2023).

In summary, MDD, GAD, and PD differentially predicted unique aspects of self-construal nine years later. Decreased self-efficacy may lead persons to see behavior due to external circumstances instead of internal mental states. Culturally sensitive treatments targeting self-efficacy can focus less on changing cognitions and behaviors because they are dysfunctional and instead emphasize changing cognitions and behaviors to better adapt to the external social environment (Hays, 2009). A conceptual framework that pits interdependence against independence may not be accurate given immigration and globalization trends, as the two may coexist (Singelis, 1994). Possessing both interdependent and independent self-construal may facilitate psychological well-being (Yamaguchi et al., 2016) through the ability to dynamically modify behavior according to the changing needs of different social contexts (Bhawuk and Brislin, 1992). Future research can focus on the predictive and moderating effects of self-construal on therapy outcomes. Therapies should keep in mind that certain aspects of self-construal could lead to psychopathology and that the experience of psychopathology itself can result in self-construal changes. Clinicians could optimize psychotherapies by being more aware of the specific culturally-mediated self-construal changes that result from depression and anxiety.

CRediT authorship contribution statement

Serena Z. Chen: Conceptualization, Formal analysis, Methodology, Validation, Visualization, Writing – original draft, Writing – review & editing. **Nur Hani Zainal:** Conceptualization, Formal analysis, Methodology, Supervision, Validation, Visualization, Writing – review & editing. **Michelle G. Newman:** Conceptualization, Supervision, Writing

– review & editing.

Declaration of competing interest

The authors have no conflicts of interest to declare.

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